

Technical Memorandum: Benefit-Cost Analysis of the Maximizing our Rural Economy on I-74 Project

Date: August 16, 2023

Subject: Benefit-Cost Analysis for the Maximizing our Rural Economy on I-74 Project

Project Description

The Maximizing our Rural Economy on I-74 Project (hereafter called the “Project”) is composed of three components that will upgrade the existing four-lane divided freeway to interstate standards:

- Mainline outside paved shoulders will be full depth, widened to 12-feet, and include rumble strips;
- Mainline inside paved shoulders will be full depth, widened to 4-feet, and include rumble strips;
- And the roadway surface will be improved through milling the old pavement down to a subbase and applying a fill of new asphalt.

The MORE I-74 Project corridor begins at I-74 / US 74 Business east of Hamlet in Richmond County (34.868920, -79.646579) and terminates where I-74 restarts and meets US 74 Business west of Laurinburg in Scotland County (34.789247, -79.505833). The Project proposes to improve 9.8 miles of US 74 to interstate standards, which will bridge the gap between existing sections of Interstate 74.

A map of the Project is shown in Figure 1 followed by a matrix in Table 1 describing the Project benefits.

Figure 1– Project Vicinity Map

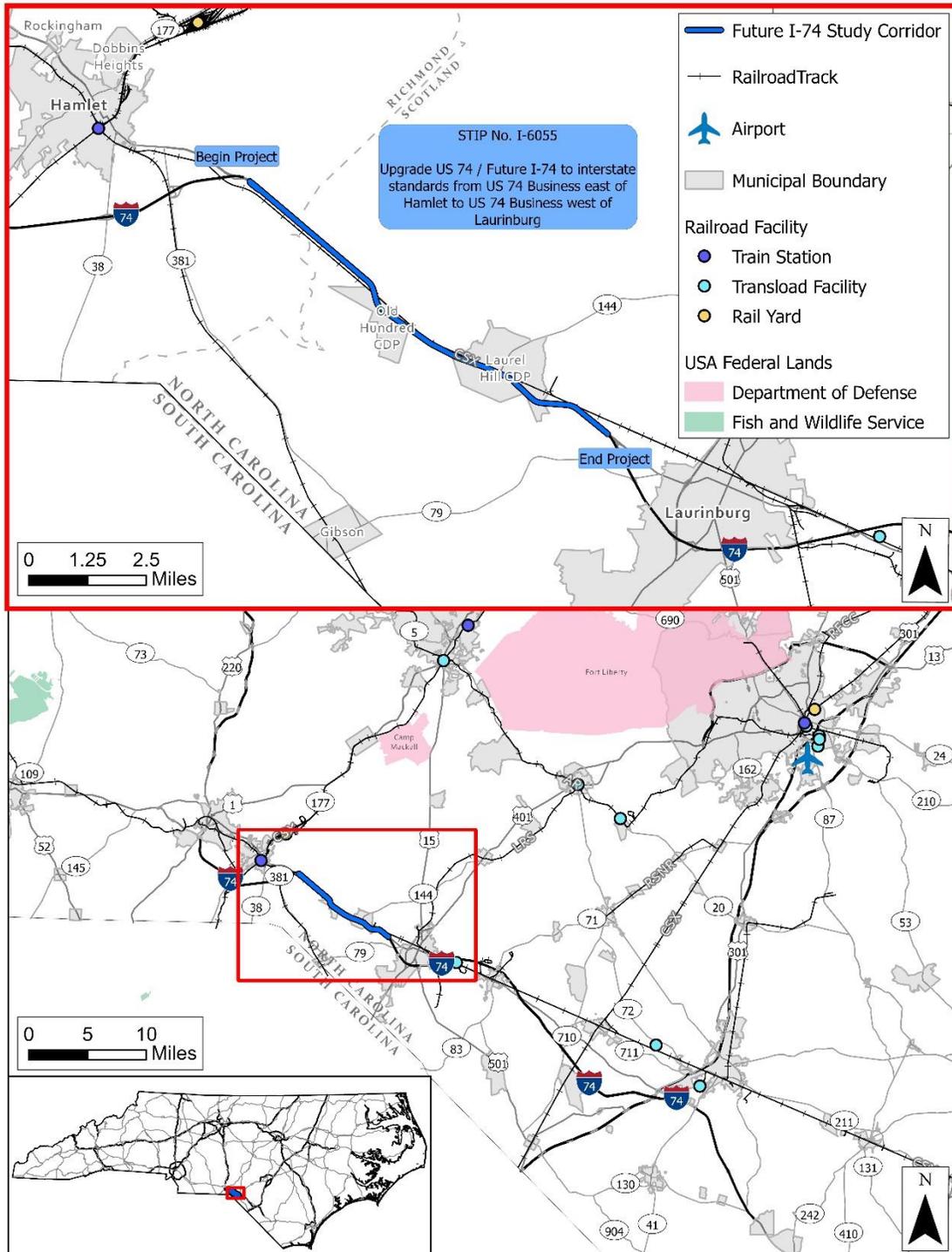


Table 1 – Project Matrix

| Current Status & Problem to be Addressed | Change to Baseline or Alternatives | Types of Impacts | Affected Population | Economic Benefit (\$2021 M) | Page Reference in BCA Memo |
|--|--|--|---------------------|-----------------------------|----------------------------|
| Shoulders width along I-74 does not meet interstate standards. | The Project includes resurfacing (mill and fill) and widening of inside and outside shoulders to interstate standards (4' and 12' respectively). | Safety: | | | |
| | | Reduced Highway Fatalities and Crashes | Corridor drivers | \$166.8 | 7 |
| | | Economic Vitality: | | | |
| Residual Value | NCDOT; Taxpayers | \$20.7 | 7 | | |

Introduction

This technical memorandum estimates the long-term benefits associated with the Project. The long-term benefits presented relate to one of the key program objectives identified in the MPDG 2023 Notice of Funding Opportunity (NOFO):¹ Safety. The results are the discounted streams of anticipated benefits and costs and the Benefit-Cost Ratios for the Project components at 7 percent.²

The Project described in this application would support the region’s economy over the long-term by providing the workforce and residents of North Carolina with improved interstate and freeway facilities that will reduce the likelihood for accidents.

The balance of this discussion describes the assumptions and methods used to develop the benefit-cost analysis and estimate the value of the long-term benefits generated by the investment. As directed in the BCA guidance, the benefits of the capital investment have been estimated over a 30-year analysis horizon. The last element of the Project would be constructed by October 31, 2034; therefore, an overall benefits period of November 2034-October 2064 was used. Partial years of benefits are accounted for in the analysis.

Benefits are estimated in accordance with guidance provided by US Department of Transportation (USDOT) for benefit-cost analysis.

The benefits quantified in the benefit-cost analysis are described in the following pages in dollars discounted to 2021 dollars. Benefits for each Project element are described within the benefit categories.

Analysis Assumptions

A list of assumptions for the project is provided in the BCA workbook (see Inputs tab in the file BCA Calculations.xls) as well as in Table 2.

Table 2- BCA Calculation Inputs

| Input | Value | Source |
|----------------|--------------|--|
| General | | |
| Discount Rate | 7% | 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs |
| Discount Rate | 3% | Sensitivity |
| Discount Year | 2021 | 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs |
| Dollar Year | 2021 | 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs |

¹ See MPDG FY 2023-2024 Notice of Funding Opportunity, <https://www.transportation.gov/grants/multimodal-project-discretionary-grant-notice-funding-opportunity>

² The summary tables are displayed using both the required 7 percent discount rate, and a sensitivity analysis is presented using a 3 percent discount rate.

| | | |
|--|--------------|--|
| Operations Start Year | 2034 | |
| Adjustment for year 1 and 31 | 0.75 | Note Project opens Oct 1, 2034 |
| Deflator | 3.21% | Historical Tables OMB The White House |
| Auto Occupancy | 1.67 | 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs |
| Annualization Factor | 365 | |
| Miles of Corridor | 22 | Feasibility Study |
| AADT (2021) | 26,833 | MM Analysis |
| AADT annual growth (2021-2053) | 2.5% | MM Analysis |
| Truck share | 10% | MM Analysis |
| Economic Vitality | | |
| Value of Time All Purposes (2021\$) | \$18.80 | 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs |
| Value of Time Truck (2021\$) | \$32.40 | |
| Safety | | |
| O- No injury (2021\$) | \$4,000 | 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs |
| C - possible injury (2021\$) | \$78,500 | |
| B - non-incapacitating injury (2021\$) | \$153,700 | |
| A - incapacitating (2021\$) | \$564,300 | |
| K - killed (2021\$) | \$11,800,000 | |
| U - Injured (severity unknown) (2021\$) | \$213,900 | |
| # Accidents Reported (unknown if injured) (2021\$) | \$162,600 | |
| Injury Crash (2021\$) | \$307,800 | |
| Fatal Crash (2021\$) | \$13,046,800 | |
| PDO per vehicle (2021\$) | \$4,800 | |

| | | |
|--|---------------|---|
| CMF | 0.63 | https://www.cmfclearinghouse.org/detail.php?facid=2831 |
| Costs | | |
| Construction Start | 2030 | NCDOT |
| Construction End | 2034 | NCDOT |
| Preliminary Engineering costs already incurred | \$10,000 | NCDOT |
| Total Capital Costs (2021\$) | \$254,134,725 | Escalated from 2017 estimate of \$224M |
| Annual O&M Costs (1% of Capital Costs) | \$0.00 | No material change in O&M costs from no-build |

Benefits

Safety

The Project elements will result in a safer facility with the upgrades reducing the number of crashes resulting in fatalities, injuries, and property damage. The monetization of these safety benefits are described in this section.

The crash reduction benefits were valued based on the KABCO score. KABCO refers to the letters used to designate five levels of crash severity used by police at a crash scene, and each type of injury has a different associated economic cost. The values of crashes avoided are shown in Table 2.

Reduced Highway Fatalities and Crashes

Based on estimates for AADT in the Project Corridor and statewide crash rates in North Carolina adjusted by the appropriate Crash Modification Factor associated with shoulder widenings (ID#2831), there are savings of 1.46 fatal (K), 10.27 injury A, B, and C, and 64.55 property damage only (PDO) crashes avoided starting in 2034. The distribution of expected injury types is important because each type of injury has a different associated economic cost as shown in Table 2. These safety reductions were applied in 2034 and assumed to grow proportional to the future I-74 traffic, or 2.5 percent per year as shown in Table 2.

Table 3 – I-74 Crash Reductions, 2034

| Year | Annual Crash Reduction (Number of Crashes), 2034 | | | | | Total |
|------|--|-------|-------|-------|-------|-------|
| | K | A | B | C | PDO | |
| 2034 | 1.46 | 10.27 | 10.27 | 10.27 | 64.55 | 96.82 |

The total reduction in fatalities, injuries, and property damage is valued as \$169.5 million, discounted at 7 percent.

Economic Vitality

The primary economic benefit is residual value. A disbenefit of increased delays during construction is also included.

Residual Value

Construction of the new roadway and interchanges would have residual value after the end of the 30-year analysis period, because the useful life of these elements is longer than 30 years. Highways and streets have a useful life of 60 years. The residual value for the Project corridor discounted at 7 percent is \$7.9 million.

Costs

Capital Costs

The capital costs are applied over a five-year construction period, beginning in 2030 and ending in 2034.

Previously incurred costs for professional engineering are estimated at \$10,000 in 2021 dollars, and were assumed to have been spent in 2021. These costs are included in the BCA.

The capital costs were discounted at 7 percent; the total discounted capital costs for the Project are \$169.47 million.

Table 4 – US-64 Construction Costs, in YOE dollars

| Year | Construction Costs (YOE\$) | Previously Incurred PE Costs (YOE\$) | Total Capital Costs (YOE\$) | Discounted Capital Total (7%) | Discounted Capital Total (3%) |
|--------------|-----------------------------------|---|------------------------------------|--------------------------------------|--------------------------------------|
| 2020 | | | | | |
| 2021 | | \$10,000 | \$10,000 | \$10,000 | \$10,000 |
| 2022 | | | | | |
| 2023 | | | | | |
| 2024 | | | | | |
| 2025 | | | | | |
| 2026 | | | | | |
| 2027 | | | | | |
| 2028 | | | | | |
| 2029 | | | | | |
| 2030 | \$21,099,881 | | \$21,099,881 | \$11,476,937 | \$16,171,302 |
| 2031 | \$87,105,184 | | \$87,105,184 | \$44,279,859 | \$64,814,438 |
| 2032 | \$89,897,580 | | \$89,897,580 | \$42,709,693 | \$64,943,925 |
| 2033 | \$92,779,494 | | \$92,779,494 | \$41,195,205 | \$65,073,671 |
| 2034 | \$71,815,347 | | \$71,815,347 | \$29,800,816 | \$48,902,757 |
| Total | \$362,697,488 | \$10,000 | \$362,707,488 | \$169,472,510 | \$259,916,092 |

Operating and Maintenance Costs

Because the project is rehabilitating existing infrastructure (reduced O&M costs) as well as building new infrastructure (increased O&M costs) the net impact is assumed to be no change in O&M costs relative to the baseline.

Summary

Table 5 summarizes the discounted value of the benefits and costs discussed in this memorandum for the total Project. Taken in total and using a 7 percent discount rate, the Project provides \$172.5 million dollars of benefits over the analysis period. Compared to a similarly discounted cost estimate, the Benefit Cost Ratio for the Project is 1.02.

The summary tables are displayed using both the required 7 percent discount rate, and an alternative 3 percent discount rate. The 3 percent discount rate is appropriate because elements of the project have long useful lives that are more appropriately discounted at a lower rate than 7 percent.

Table 5 – Total Project Benefit-Cost Analysis (2034-2064 in 2021 \$M)

| Total Benefit-Cost Analysis Results | Discounted at 7% | Discounted at 3% |
|--|-------------------------|-------------------------|
| Costs | | |
| Capital Costs | \$169.5 | \$259.9 |
| Total Costs | \$169.5 | \$259.9 |
| Benefits | | |
| Safety | | |
| Reduced Highway Fatalities and Crashes - Auto | \$150.1 | \$402.4 |
| Reduced Highway Fatalities and Crashes - Truck | \$16.7 | \$44.7 |
| Sub-Total Safety Benefits | \$166.8 | \$447.1 |
| Economic Vitality | | |
| Residual Value | \$7.9 | \$40.7 |
| Delays During Construction - Auto | -\$2.0 | -\$3.1 |
| Delays During Construction - Truck | -\$0.2 | -\$0.4 |
| Sub-Total Economic Vitality | \$5.7 | \$37.3 |
| O&M Costs | \$0.0 | \$0.0 |
| Net O&M | \$0.0 | \$0.0 |
| Total Benefits | \$172.5 | \$484.4 |
| BC Ratio | 1.02 | 1.86 |
| Net Present value | \$3.0 | \$224.5 |

List of Supporting Information

MM, NCDOT_MORE I-74_MPDG_2023BCA.xls (Excel spreadsheet with BCA calculations by benefit type and summary)

Bureau of Economic Analysis Rate of Depreciation, Service Lives, Declining-Balance Rates, and Hulten-Wyckoff Categories

USDOT, January 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs,

USDOT, MPDG FY2023-2024 Notice of Funding Opportunity,
<https://www.transportation.gov/grants/multimodal-project-discretionary-grant-notice-funding-opportunity>

Crash Modification Clearinghouse, <https://www.cmfclearinghouse.org/detail.php?facid=2831>